

**CLAIMS**

1. Plasma doping apparatus comprising:

a housing defining a plasma doping chamber;

a platen for supporting a workpiece in said plasma doping chamber, said platen

coupled to a reference potential;

an anode spaced from said platen in said plasma doping chamber;

a process gas source coupled to said plasma doping chamber, wherein a plasma containing ions of the process gas is produced in said plasma doping chamber between said anode and said platen, said plasma having a plasma sheath in the vicinity of the workpiece;

a vacuum vessel enclosing said plasma doping chamber and defining an outer chamber;

a primary vacuum pump connected to said vacuum vessel;

a pulse source for applying pulses to said anode for accelerating said ions across the plasma sheath toward said platen for implantation into the workpiece; and

a controller for establishing a controlled plasma doping environment in the plasma doping chamber in a first mode and for establishing a gas connection between the plasma doping chamber and the outer chamber in a second mode.

2. Plasma doping apparatus as defined in claim 1 wherein said plasma is produced by the pulses applied to said anode.

3. Plasma doping apparatus as defined in claim 1 wherein said plasma is pulsed.

4. Plasma doping apparatus as defined in claim 1 wherein said plasma is continuous.

5. Plasma doping apparatus as defined in claim 1 further comprising a secondary vacuum pump connected to said plasma doping chamber for pumping said plasma doping chamber in the first mode.

6. Plasma doping apparatus as defined in claim 1 further comprising a controlled conductance aperture between said plasma doping chamber and said outer chamber, wherein

said plasma doping chamber is pumped through said controlled conductance aperture in the first mode.

7. Plasma doping apparatus as defined in claim 1 further comprising a hollow electrode surrounding a space between said platen and said anode, and electrically connected to said anode.

8. Plasma doping apparatus as defined in claim 1 further comprising a hollow electrode surrounding a space between said platen and said anode, and a hollow electrode pulse source electrically connected to said hollow electrode, wherein said plasma is produced by the pulses applied to said anode and the pulses applied to said hollow electrode.

9. Plasma doping apparatus as defined in claim 1 wherein said housing is coupled to the reference potential.

10. Plasma doping apparatus as defined in claim 1 wherein said ions are positive ions and wherein said pulses are positive pulses.

11. Plasma doping apparatus as defined in claim 1 wherein said ions are negative ions and wherein said pulses are negative pulses.

12. Plasma doping apparatus as defined in claim 1 wherein said platen is electrically connected to ground.

13. Plasma doping apparatus as defined in claim 1 wherein said platen is movable between a processing position sealed into said plasma doping chamber and a retracted position removed from said plasma doping chamber and wherein said controller comprises means for moving said platen between the processing position in the first mode and the retracted position in the second mode.

14. A plasma doping method comprising the steps of:

providing a plasma doping chamber containing a platen coupled to a reference potential and an anode spaced from the platen;

supporting a workpiece on the platen;

supplying a process gas to the plasma doping chamber, wherein a plasma containing ions of the process gas is produced in said plasma doping chamber between said anode and said platen, said plasma having a plasma sheath in the vicinity of the workpiece;

enclosing the plasma doping chamber within a vacuum vessel that defines an outer chamber;

vacuum pumping the vacuum vessel with a primary vacuum pump;

applying pulses to the anode for accelerating the ions across the plasma sheath toward the platen for implantation into the workpiece; and

controlling the apparatus to establish a controlled plasma doping environment in the plasma doping chamber in a first mode and to establish a gas connection between the plasma doping chamber and the outer chamber in a second mode.

15. A plasma doping method as defined in claim 10 further comprising the step of controllably moving said platen between a processing position sealed into said plasma doping chamber in the first mode and a retracted position removed from said plasma doping chamber in the second mode.

16. A plasma doping method as defined in claim 14 wherein the step of applying pulses to the anode produces the plasma in said plasma doping chamber.

17. A plasma doping method as defined in claim 14 comprising the step of producing a pulsed plasma.

18. A plasma doping method as defined in claim 14 comprising the step of producing a continuous plasma.

19. A plasma doping method as defined in claim 14 further comprising the step of vacuum pumping said plasma doping chamber in the first mode with a secondary vacuum pump connected to said plasma doping chamber.

20. A plasma doping method as defined in claim 14 further comprising the step of vacuum pumping said plasma doping chamber in the first mode with said primary vacuum pump, wherein said primary vacuum pump communicates with said plasma doping chamber through a controlled conductance aperture between said plasma doping chamber and said outer chamber.

21. A plasma doping method as defined in claim 14 further comprising the step of vacuum pumping said plasma doping chamber in the second mode with said primary vacuum pump.

22. A plasma doping method as defined in claim 14 further comprising the steps of providing a hollow electrode surrounding a space between said platen and said anode, and electrically connecting said hollow electrode to said anode.

23. A plasma doping method as defined in claim 14 further comprising the steps of providing a hollow electrode surrounding a space between said platen and said anode, and electrically connecting said hollow electrode to a hollow electrode pulse source for applying pulses to said hollow electrode, wherein said plasma is produced by the pulses applied to said anode and the pulses applied to said hollow electrode.

24. A plasma doping method as defined in claim 14 further comprising the step of electrically connecting the plasma doping chamber to the reference potential.

25. A plasma doping method as defined in claim 14 wherein said platen is coupled to ground.